Ideas for an LHC Theory Center

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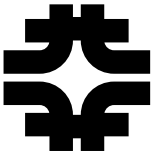

Fermilab Long Range Planning Committee
Open Meeting on LHC

Fermilab, September 4, 2003.

Ideas for an LHC Theory Center

- Introduction:
  Why do we need a Theory Center?
- Basic Characteristics
- Other Features:

– Location/s
– Operation

$\Longrightarrow$ Define structure for the first year and evolution in coming years

– New Positions
– Composition

- Synergy with US LHC Experiment Centers
- General Discussion

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Why do we need a US LHC Theory Center?

• At the start of the next decade, the LHC will be the only operating facility at the high energy frontier – and the US has already invested a quite significant portion of the HEP budget there.

• We expect the LHC to bring new discoveries and hopefully some surprises:
$\Longrightarrow$ The US-based theory community should be in a position to play a major role in the proper understanding of LHC data
This task will be quite demanding and coordination will be very valuable.

• A US LHC Theory Center will enhance the efforts of the US CMS and ATLAS Physics Centers and will increase the synergy between theory and experiment.

• It will facilitate the interactions among postdocs, university professors and scientists, nucleating a critical mass of people with similar interests in LHC Physics, at the center location/s for fixed periods of time.

• The time is ripe to crystalize analysis strategies for the LHC!!

Main Characteristics

• **US** LHC Theory Center with connections to both CMS and ATLAS (also LHCB)

• Include broad spectrum of theorists: 3 groups

⋆ Collider Phenomenologists
$\Longrightarrow$feasability studies of the latest theoretical ideas in the context of the LHC collider experiments
$\Longrightarrow$ refine and extend existing studies of well established theoretical ideas
QCD and electroweak SM precision measurements
SUSY, Extra Dimensions, Strong Dynamics, Little Higgs
$\Longrightarrow$ further develop theoretical tools to match the experimental precision and maximally exploit the measurements

⋆ Experts in MC and other computational techniques
$\Longrightarrow$ implementation of best theoretical calculations in programs used in real data analysis
A synergy between some theorists and each collaboration will become necessary to bridge theory and experiment

⋆ Model Builders
$\Longrightarrow$ to bring in the latest theoretical ideas
(Members or visitors at the FNAL theory group)

Composition, Location, Operation and Positions

Composition

• Open to all US-based theorists with interest in Model building, LHC collider phenomenology and experts in computational techniques.

• Organizing Committee for the LHC Theory Center: composed of LHC theory Center members plus Fermilab theory members associated to the Center.

Location

To assure the US-wide participation of theorists in the Center:

$\Longrightarrow$ more that one location

$\Longrightarrow$ rotate meetings among different locations

Main locations should naturally be attached to the main areas of US CMS/ATLAS activities.

Fermilab: one main location of the Theory Center

• It is the US CMS Physics Center

• Already has a large Theory Group with broad expertise in subjects relevant for LHC physics

• Fermilab by conception is a *users* oriented laboratory: perfect place to locate a HEP *users* Theory Center.

Important Issue:

The relation between the Fermilab Theory Group and the LHC Theory Center

- The Fermilab Theory Group has its own role in Theoretical Developments and Lab. Activities

$\Longrightarrow$ much broader scope: Lattice gauge theories, Perturbative QCD, Flavor Physics, Higgs Physics, Model Building, Supersymmetry, Strong Dynamics, Strings, D-Branes, Extra Dimensions, Neutrino Physics, RUN II Physics, LHC Physics and Linear Collider Physics.

- LHC Theory Center not necessarily a part of the Fermilab Theory Group but rather an independent entity with many Theory Group members as active contributors to the LHC theory Center.

Other Locations:

$\star$ BNL $\rightarrow$ the ATLAS Physics Center with theorists already importantly involved in LHC Physics

$\star$ Other laboratories with big impact on LHC Physics studies: LBL, Argonne, SLAC

$\star$ Universities with large groups at LHC experiments and with interested theorists.

Operational structure

⋆ Present idea at the *International Workshop on Future Hadron Colliders*, Fermilab, October 16-18, 2003

⋆ Discussion session about how to implement the ideas of the LHC Theory Center with the US-wide community, *KITP Collider Physics workshop*, Sta Barbara, Jan. 2004

⋆ Organizational meeting at Fermilab, Spring 2004, to:

(1) Discuss Tevatron physics and implementation of new computational techniques. How will the information obtained from the Tevatron shape LHC Physics?

(2) Evaluate ongoing efforts to improve on theoretical calculations and techniques in all topics relevant for LHC

(3) Identify important areas in which further work is needed and define a strategy for theory Center members to contribute to it.

⋆ One or two more meetings in specific phyiscs topics which will also serve to evaluate development of research activities in those areas. Define ways of obtaining funds for the long term operation of the Center.

Important:

The Center should be not only a place to present and discuss results with colleagues, but also should provide a good environment to work and generate interesting research projects for younger scientists.
It should also be a place for theorists and experimentalists to interact and collaborate as closely as possible

Positions

Besides **regular meetings** and **yearly workshops**

- Positions for Collider phenomenologists and Experts in computational techniques, to promote long term collaborations and interactions with experimentalists.

$\Longrightarrow$ Need for real commitment of Labs/DOE/NSF funds.

Many possibilities

- At sabbatical level for senior researchers,
- 3-5 year positions for younger scientists.
- short term visitors.

Important Issues and Possible Objections

⋆ Where does the funding comes from?
Labs/DOE/NSF/Private Funding

⋆ How will the Center impact positions at the labs and universities?
Possitively, if members profit significantly from the critical mass of researchers at the LHC Theory Center and from interactions with experimentalists.

⋆ Where locate the Center at Fermilab:
close to the theory group, close to the CMS physics center?

⋆ How does the Center relate to the FNAL Theory Group?
⋆ Why not just add visitors and postdocs to the FNAL Theory Group?

- LHC Theory Center can be operated by a community-based committee of university and lab theorists. Decisions on visitor program and fellowships to be made by users.

- A self-contained center will more easily attract the best experts in LHC related topics as visiting fellows.

- A self-contained center will have better focus, and interface better with the USCMS Physics Center.

- LHC Theory Center has specialized support needs (e.g. computing), so combining with FNAL Theory will not save on overhead/infrastructure costs.

- The Fermilab Theory group has a broad spectrum of theoretical activities.
The LHC Theory Center will attract a critical mass of researches with a specific profile: world experts in computational techniques relevant for LHC

Goals and Outlook

At the start of the next decade, the high energy frontier will be overseas and the US HEP physics should increase efforts to continue playing a leading role in that domain.

The US LHC theory center aims to:

- help strengthen and further develop the theory program for the vast domain of hadron collider physics.
- have a positive impact on the US LHC experimental efforts.

For Fermilab:

The theory center hopes to add to the efforts of the US CMS analysis center in their goal to make Fermilab *the place to come to do prime LHC physics analyses*.